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UNITED STATES
DEPARTMENT OF THE INTERIOR
HAROLD L. ICKES, SECRETARY

BUREAU OF MINES
R. R. SAYERS, DIRECTOR

INFORMATION CIRCULAR

TESTING RESPIRATORY PROTECTIVE EQUIPMENT FOR APPROVAL

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BY

H. H. SCHRENK

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UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

TESTING RESPIRATORY PROTECTIVE EQUIPMENT FOR APPROVAL[1]

By H. H. Schrenk[2]

INTRODUCTION

The purpose of respiratory protective equipment is to prevent the inhalation of harmful or objectionable atmospheres. Although constituents or contaminants that may render an atmosphere irrespirable or objectionable are numerous, they may be classified broadly as follows:

- I. Gaseous substances.
    - A. Toxic.
    - B. Inert (oxygen deficiency).
- II. Particulate matter (dispersoids).
    - A. Solid.
        - a. Dust (formed by disintegration).
        - b. Fume (formed by condensation).
    - B. Liquid.
        - a. Mist (formed by disintegration).
        - b. Fog (formed by condensation).

The contaminants have been divided into two main groups on the basis of their physical state, that is, whether gaseous or particulate matter. The gaseous substances have been divided into two subgroups on the basis of physiological action, that is, whether toxic or inert. The toxic or poisonous contaminants may produce harmful or objectionable response in relatively low concentrations, whereas the inert substances produce undesirable effects primarily by displacement of oxygen.

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[1] The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from Bureau of Mines Information Circular I. C. 7130. Presented at annual meeting of American Institute of Mining and Metallurgical Engineers, New York, N. Y., February 12-15, 1940.

[2] Chief chemist, Health Division, Bureau of Mines, Pittsburgh, Pa.

The particulate contaminants have been divided into two main groups on the basis of physical state, namely, whether liquid or solid. These groups have been divided into two subgroups, each depending on the method of formation. Solid particles formed by disintegration processes, such as blasting, grinding, crushing, and drilling, are called "dust"; solid particles formed by condensation of vapor such as lead oxide from burning lead are called "fume". Liquid particles formed by disintegration, as in spraying, are called "mist"; and liquid particles formed by condensation, such as water vapor, are called "fog".

KINDS OF RESPIRATORY PROTECTIVE EQUIPMENT

Numerous devices, generally for some specific application, have been developed to protect against the various kinds and combinations of atmospheric contaminants. Although these devices have been named in an unrelated manner their fundamental operating characteristics are so similar that they may be classified broadly as follows:

I. Contaminant-removing (air-purifying) respirators or masks.

  A. Gas respirators or masks (ordinarily designated gas masks).
  B. Dispersoid respirators (dust, fume, mist, and fog respirators).

II. Atmosphere-supplying respiratory equipment.

  A. Self-contained type (oxygen breathing-apparatus).

  B. Hose type (supplied-air respirators - hose masks, air-line respirators, and abrasive blasting helmets, hoods and masks).

The respiratory equipment has been divided into two main groups - those affording protection by removal or conversion of contaminants and those affording protection by supplying a respirable atmosphere from an uncontaminated source.

Contaminant-Removing Respiratory Equipment

Respiratory equipment designed to remove contaminants may be considered as air-purifying or contaminant-removing devices. Such equipment may be divided into two subgroups, one for gaseous contaminants and the other for particulate matter (dust, fume, mist, and fog) which may be referred to collectively as "dispersoids." Gaseous contaminants are removed by chemical or physical means, such as oxidation, neutralization, or adsorption. Dispersoids are removed apparently by sieving, impingement, electrostatic charge, and other phenomena.

Atmosphere-Supplying Respiratory Equipment

Respiratory equipment or devices that furnish the wearer with a respirable atmosphere from a source independent of the wearer's immediate atmospheric environment have been divided into two subgroups - a self-contained type, in which the supply of oxygen (or material from which the oxygen can be generated) is carried by the wearer; and a hose type, in which the wearer may obtain air from an uncontaminated source through a hose or tube.

BRIEF HISTORY OF DEVELOPMENT OF RESPIRATORY EQUIPMENT

Respiratory equipment and devices apparently originated in ancient times, and some medium for filtering out dust probably was the first step in their development. The use of loose bladder skins over the face to protect against the inhalation of vermilion dust was described by Pliny the Elder (23-79 A. D.), and the employment of fibrous materials to prevent inhalation of dust generated in mining operations was mentioned by Agricola in the sixteenth century.

The use of a hose or tube to furnish fresh air to divers is also of ancient origin. Bellows were employed as early as the beginning of the seventeenth century as a source of a positive pressure of air for diving.

These two types of devices apparently were the only ones available until comparatively recent times. It is interesting to note, however, that the two types represent the two fundamental methods that have been used in the development of respiratory equipment, namely, removing contaminants and supplying respirable atmospheres.

Oxygen breathing-apparatus and gas masks were developed about the middle of the nineteenth century. The oxygen breathing-apparatus introduced into the United States from Europe about 1907 or 1908 came into wide use with the creation of the Bureau of Mines in 1910, and the gas mask had its real development during the World War of 1914-18. Interest in respiratory protective devices for industrial use was renewed after the war, and many improvements were made. In the last few years there has been a marked increase in interest in respirators, probably because of the emphasis that has been placed on industrial hygiene, and again marked improvements have been made.

APPROVAL TESTING OF RESPIRATORY EQUIPMENT BY THE BUREAU OF MINES

The Bureau of Mines, since its creation in 1910, has worked with equipment for giving respiratory protection against harmful atmospheres. There was a definite need for such equipment for use in dangerous mine atmospheres, particularly those created by mine fires and explosions. Owing to the fact that frequently these atmospheres were deficient in oxygen, it was necessary to furnish a person entering such an atmosphere with air or oxygen from another source. As the oxygen breathing-apparatus appeared to fit these needs very well, work was begun first on this equipment, which eventually led to the development of American types of this device.

Because of its experience with apparatus for protecting against toxic gases, the Bureau of Mines was assigned the problem of developing a military mask for the American soldiers during the last war. After the war the Bureau continued work on gas masks because of the obvious possibilities of modifying them for protection against gas hazards in the mining and allied industries.

To promote the development and manufacture of respiratory equipment of known good quality, the Bureau of Mines prepared what it considered to be minimum requirements for safe and durable equipment and devised methods for testing the devices for conformity to these requirements. A schedule for testing oxygen breathing-apparatus[3] was issued March 5, 1919, and was followed on May 22, 1919, by a schedule for testing gas masks.[4] The first oxygen breathing-apparatus was approved January 15, 1920, and the first gas mask April 10, 1920.

Following work with gas masks, the Bureau turned its attention to the present hose mask. This device was designed to give protection against high concentrations of gases and vapors or a deficiency of oxygen (for which the gas mask is ineffective) and at the same time to be lighter, simpler, and cheaper than self-contained oxygen breathing-apparatus. The device was needed not so much for emergency as for routine purposes, such as entering manholes, tanker compartments, gasoline tanks, and other confined spaces that were relatively short distances from a source of respirable air. A schedule[5] for testing this type of device for approval was issued April 28, 1927, and the first approval was granted May 29, 1929.

Considerable work was done by the Bureau of Mines on dispersoid (dust, fume, mist, and fog) respirators during 1925 and 1926, and further work was done in 1932, 1933 and 1934. An approval schedule[6] for devices of this type was issued August 20, 1934, and the first respirator was approved January 7, 1935. Because of the increased interest in respiratory protective devices, the Bureau enlarged its schedule for testing hose masks to include all types of supplied-air respirators, that is, hose masks, air-line respirators, and abrasive blasting helmets, hoods, and masks. This revised and enlarged schedule was issued in August 1937. The first type-C supplied-air respirator (air-line respirator) was approved July 15, 1938, and the first type-C CE abrasive blasting respirator (abrasive blasting mask) also was approved July 15, 1938.

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[3] Bureau of Mines, Procedure for Establishing a List of Permissible Self-Contained Mine Rescue Breathing-Apparatus, Fees, Character of Tests, and Conditions Under Which Mine Rescue Breathing Apparatus Will Be Tested: Sched. 13, March 5, 1919, 13 pp.; Sched. 13A (revision of Sched. 13), January 21, 1930, 12 pp., Sched. 13B (revision of Sched. 13A), August 12, 1935, 12 pp.

[4] Bureau of Mines, Procedure for Establishing a List of Permissible Gas Masks. Fees, Character of Tests, and Conditions Under Which Gas Masks Will Be Tested: Sched. 14, May 22, 1919, 13 pp.; Supplement to Sched. 14, January 6, 1920, 4 pp.; Sched. 14A (revision of Sched. 14), August 25, 1923, 15 pp.; Sched. 14B (revision of Sched. 14A), August 7, 1930, 13 pp.; Sched. 14C (revision of Sched. 14B), August 20, 1934, 17 pp.; Sched. 14D (revision of Sched. 14C), May 9, 1935, 17 pp.

[5] Bureau of Mines, Procedure for Testing Hose Masks for Permissibility: Schedule 19, April 28, 1927, 8 pp.; Supplement to Schedule 19, August 20, 1934, 3 pp.; Procedure for Testing Supplied-Air Respirators for Permissibility: Schedule 19A (revision of Schedule 19 and Supplement, enlarged to include special hose masks without blowers, air-line respirators, and abrasive blasting helmets, hoods, or masks), August 9, 1937, 21 pp.

[6] Bureau of Mines, Procedure for Testing Filter-Type Dust, Fume, and Mist Respirators for Permissibility: Sched. 21, August 20, 1934, 14 pp.

Basic Considerations and General Requirements

Certain basic requirements apply to all types of respiratory equipment. These requirements are as follows: (1) They must give adequate protection; (2) they must be reasonably comfortable and physically convenient to wear; (3) they must provide an acceptable period of protection; and (4) they must be constructed of durable materials.

General requirements of the Bureau of Mines for approval testing are as follows: The manufacturer must file an application that shall contain (1) a description and complete drawings of the device; (2) a statement that the device is completely developed and of the design and materials that the manufacturer believes suitable for a finished marketable device; (3) a statement that the device has been subjected to inspections and tests as described in the schedule and that it met these requirements when tested by the manufacturer or his testing agency; and (4) a statement describing the nature, adequacy, and continuity of control of the quality of the equipment. No respiratory equipment will be accepted for permissibility tests unless it is substantially in the completed form in which it is to be marketed.

Inspection and Performance Requirements

The detailed requirements and tests for the various types of devices are described in the respective schedules and are not presented here. A brief résumé is given to show the nature and severity of the tests.

Design and Construction

The equipment is disassembled and inspected to ascertain whether the design is consistent with known mechanical and physiological principles as well as with comfort, safety, and practicability. The construction is examined from the standpoint of safety, durability, and ease of inspection, repair, and sterilization.

As a result of the examination, changes that will improve the comfort, safety, or efficiency of the apparatus frequently are suggested. Usually these suggestions are followed by the manufacturer to improve his apparatus even though they may not be necessary to pass the prescribed schedule of tests.

Performance Tests

The devices are subjected to both laboratory and man tests designed to reveal quality and performance under conditions that simulate those of actual use.

Laboratory tests. - Laboratory tests are designed to test the efficiency of the equipment under a wide variety of conditions and to determine resistance to inhalation and exhalation, which is a significant comfort factor.

The efficiency and service life of gas-mask canisters are ascertained by testing them against a wide range of gas-air concentrations and rates of flow. They are tested as received and also after equilibration for 6 hours with air having a relative humidity of 25 percent and 85 percent, respectively. These tests are made to ascertain the chemical stability of the absorbents. Canisters for use against carbon monoxide are tested at 0° C. to determine whether the activity of the catalyst is affected significantly by low temperatures. Canisters are tested against a maximum of 2 percent of gas by volume, except the ammonia canister, which is tested against 3 percent.

Dispersoid (dust, fume, mist, and fog) respirators are tested against relatively high concentrations of quartz dust, lead dust, chromic acid mist, siliceous mist, lead-paint mist, or lead fume, depending on the purpose for which the device is designed. The efficacy of a respirator is based not on percentage efficiency but on the so-called permissible limits; that is, the leakage shall not exceed the amount considered safe to breathe. The device must have a reasonable service period before its resistance to a flow of 85 liters per minute exceeds 2 inches of water; that is, the filter must be able to retain considerable dust without undue increase in resistance.

Supplied-air respirators supply the wearer with respirable air from a source that is outside the contaminated zone. Although their function is not purification of the air, they must not allow the transported air to become contaminated. The air-supply line must be essentially airtight. It must not be permeable to gasoline vapors. To test for this requirement the hose is submerged for 6 hours in liquid gasoline, and air is passed through the hose at a rate of 8 liters per minute. The leakage must not exceed 0.01 percent. The hose must not kink, and for the type-A supplied-air respirator (hose mask) the hose must be able to withstand a pressure of 200 pounds applied on a 3-inch plane, as a protection against shutting off the wearer's supply of air. The couplings and hose of the hose mask must withstand a pull of 250 pounds, so that there will be little, if any, danger of separation and that it may be used to recover the wearer if a life-line has been neglected. (A life line is recommended, and use of the hose for this purpose should be an emergency measure only.)

The flow of air through the supply line is determined under a wide range of conditions, so that proper flows and pressures can be specified.

Moreover, for the hose mask the power requirements of the air-supply device must be small. The resistance to inhalation on the hose mask (with blower not in operation) must not exceed 2.5 inches of water at 85 liters per minute, so that the wearer can obtain air without undue effort even if the blower ceases to function.

Although emphasis usually is placed on resistance to inhalation, and rightly so, resistance to exhalation also is important and is not permitted to exceed 1 inch water pressure at 85 liters per minute for all devices except gas masks, for which 1.5 inches is permitted. Consideration will be given to reducing this to 1 inch when the schedule is revised.

Man tests. - The laboratory tests yield much valuable information, but the final decision depends on the performance of the device when worn by persons under actual conditions of use and in maximum concentrations of contaminants for which the device is approved or concentrations that are considered to give an adequate test of the efficacy of the device.

Gas masks, for example, are worn in 2 percent carbon monoxide, various acid gases such as sulfur dioxide and phosgene, organic vapors such as carbon tetrachloride and 3 percent ammonia. The device must give protection for 30 minutes without evidence of leakage when worn during moderately strenuous exercise. This tests not only the efficacy of the canisters but also the gastightness of the device as a whole.

The dispersoid respirator is worn while coal dust is blown into the face. If no leakage occurs there is a sharp line of demarcation at the point of contact of the facepiece with the face.

Supplied-air respirators are worn in 1 percent ammonia and a high concentration of dust. Abrasive blasting devices are worn during sand blasting. Samples of air are taken from the facepiece while it is being worn in the high concentration of dust or during sand blasting and the quantity of dust determined.

The man tests not only check the efficiency of the apparatus but also give information on comfort, freedom of movement, field of vision, and practicability.

Requirements Subsequent to Approval

Notification of approval is accompanied by photographs of a design of the approval plates that the manufacturer must use in labeling the approved device. An approval label is attached to the container for the entire device, and another label is used on the canisters for gas masks or on the container for the filter elements in dispersoid respirators. The approval label states the purpose for which the device is approved and of what the approved assembly consists, and cautions as to its limitations. In addition, various essential parts of the device such as facepiece, filter elements, hose, etc., are marked with the approval number to aid in identification and guard against replacement with nonapproved or improper parts. The approval applies only to the complete device and not to its component parts. The Bureau also assists in the preparation of the instruction cards that accompany the devices.

As a record of approved devices the Bureau requires the manufacturer to submit two complete sets of drawings of the device and one complete device properly labeled. The manufacturer is not permitted to make any changes in an approved device without submitting it to the Bureau for an extension of approval.

In granting approvals consideration is given to the provisions and facilities of the manufacturer for maintaining the quality of his device. If the quality of an approved device falls below the approval requirements the manufacturer is notified, and if he does not take immediate steps to remedy the situation approval of his device is rescinded.

APPROVALS GRANTED

Table 1 lists the number of approvals that have been granted on respiratory protective equipment. The number of approvals of each type of device is given for each year from the first approval in 1920 to the end of 1939, as well as the grand total for the entire period. From 1920 to 1934, inclusive, when the Bureau first had in force approval schedules for oxygen breathing-apparatus, gas masks, and hose masks, 23 approvals were granted (an average of about 1.5 a year) and the maximum in any 1 year was 3. From 1935 to 1939, inclusive, 60 approvals were granted (an average of about 12 a year). In 1939 alone 21 approvals were granted, or almost as many as were granted during the 15-year period, 1920 to 1934, inclusive. A total of 83 approvals has been granted, of which 60 (almost three-fourths) have been granted since 1934. A list[7] of approved devices is published from time to time.

The success of the approval system depends largely on the demand of the consumer for approved devices, which in turn stimulates the manufacturer to seek approval. In this connection it is of interest to review some improvements that have been made in respiratory equipment since the Bureau began approval of such equipment.

Mechanically oxygen breathing-apparatus has improved greatly and present equipment is lighter in weight. When the first approval schedule for gas masks was issued a resistance of 6 inches of water was permitted. In the most recent schedule for gas masks, issued in 1935, the resistance permitted was 3.5 inches of water, or only slightly more than half the original requirement. There has been a significant decrease in the dead-air space in the facepieces, and the field of vision has been greatly increased.

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[7] Schrenk, H. H., List of Respiratory Protective Devices Approved by the Bureau of Mines: Bureau of Mines Inf. Circ. 7030, July 1938, revised February 1939, 9 pp.

TABLE 1. - Bureau of Mines approvals granted on respiratory protective devices

Year	Oxygen breathing-apparatus	Gas masks	Supplied-air respirators	Dust respirators	Total
1920	2	1	-	-	3
1924	1	1	-	-	2
1925	1	1	-	-	2
1926	-	1	-	-	1
1928	-	4	-	-	4
1929	1	-	1	-	2
1930	-	2	-	-	2
1931	1	2	1	-	4
1932	-	0	-	-	0
1933	-	2	1	-	3
1934	-	-	1	-	1
1920-34	6	14	4	-	24
1935	-	-	2	8	10
1936	-	1	-	5	6
1937	1	1	-	5	7
1938	-	3	6	7	16
1939	-	6	4	11	21
1935-39	1	11	12	36	60
1920-39	7	25	16	36	84

There has been a marked improvement in dispersoid (dust, fume, mist, and fog) respirators in the last few years. The fit of the facepiece is better, and there is less dead-air space. The filter elements have been definitely improved, to give not only greater filtering efficiency but also a lowered resistance to inhalation.

SUMMARY

A brief review is given of the approval of respiratory equipment by the Bureau of Mines. The general requirements, basic considerations of the schedules, essentials of the test requirements, and past approval requirements are presented. The number of respirators of each kind approved annually from 1920 to 1939, inclusive, is given in tabular form.

When using respirators ask yourself these questions:

Have you Selected the proper type?
Is it Approved?
Does it Function properly (maintenance)?
Have you Explained its use (instruction - supervision)?

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January 1941

UNITED STATES
DEPARTMENT OF THE INTERIOR
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BUREAU OF MINES
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LIST OF RESPIRATORY PROTECTIVE DEVICES APPROVED BY THE BUREAU OF MINES

BY

H. H. SCHRENK

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UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

LIST OF RESPIRATORY PROTECTIVE DEVICES APPROVED BY THE BUREAU OF MINES[1]

By H. H. Schrenk[2]

One phase of Bureau of Mines work in health and safety is promotion of the use of safe, satisfactory, and reliable respiratory protective devices. To insure that devices embodying these features will be available the Bureau has established schedules of minimum requirements for oxygen breathing apparatus[3], gas masks[4], supplied-air respirators (hose masks, air-line respirators, and abrasive blasting helmets, hoods, or masks)[5], and dispersoid (dust, fume, and mist) respirators[6]. Approval tests of oxygen-breathing apparatus are conducted by the Safety Division; approval tests of other types of respiratory protective equipment are conducted by the Health Division. These divisions comprise the Health and Safety Branch.

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[1] The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from Bureau of Mines Information Circular 7030R." This circular was first issued in July 1938; a revision was issued in February 1939 and supplements from time to time as needed.

[2] Chief chemist, Health Division, Bureau of Mines.

[3] Bureau of Mines, Procedure for Establishing a List of Permissible Self-contained Mine Rescue Breathing Apparatus. Fees, Character of Tests and Conditions under Which Mine Rescue Breathing Apparatus Will be Tested: Sched. 13, March 5, 1919, 13 pp.; Sched.13A (revision of Sched.13), January 21, 1930, 12 pp.; Sched. 13B (revision of Sched. 13A), August 12, 1935, 12 pp.

[4] Bureau of Mines, Procedure for Establishing a List of Permissible Gas Masks. Fees, Character of Tests, and Conditions Under Which Gas Masks Will Be Tested: Sched. 14, May 22, 1919, 13 pp.; Supplement to Sched.14, Jan. 6, 1920, 4 pp. Sched. 14A (revision of Sched. 14), August 25,1923, 15 pp.; Sched. 14B (revision of Sched. 14A), August 7, 1930, 13 pp.; Sched. 14C (revision of Sched. 14B), August 20, 1934, 17 pp.; Sched.14D (revision of Sched. 14C), May 9, 1935, 17 pp.

[5] Bureau of Mines, Procedure for Testing Hose Masks for Permissibility: Sched. 19, April 28, 1927, 8 pp. Supplement to Sched. 19, August 20, 1934, 3 pp. Bureau of Mines, Procedure for Testing Supplied-air Respirators for Permissibility: Sched. 19A (revision of Sched. 19 and supplement, enlarged to include special hose masks without blowers, air-line respirators and abrasive blasting helmets, hoods, or masks), August 9, 1937, 21 pp.

[6] Bureau of Mines, Procedure for Testing Filter-type Dust, Fume, and Mist Respirators for Permissibility: Sched. 21, August 20, 1934, 14 pp.

Manufacturers of respiratory protective devices may submit their equipment to the Bureau of Mines for approval under the requirements of these schedules. As a prerequisite to testing, the Bureau requires statements to the effect (1) that the device is completely developed and of the design and materials that the manufacturer believes suitable for a finished marketable device and (2) that the device has been subjected to inspections and tests such as are described in the schedules and that it met those requirements when tested by the manufacturer or his testing agency; and (3) a statement regarding the nature, adequacy, and continuity of control of the quality of the respirator. If the manufacturer can satisfy these requirements and if the device, when tested by the Bureau, meets its requirements a certificate of approval will be granted by the Bureau of Mines, which not only states that the equipment has passed the schedule of requirements but also gives information about its limitations. If it is found at any time that approved devices purchased in the open market and tested do not meet the requirements of the schedule the Bureau may rescind approval.

Lists of approved devices are published periodically for the information of the public. The last published list (Information Circular 6952) lists all devices approved to April 10, 1937.

LIST OF APPROVED DEVICES

November 1, 1940

Following is a list of all respiratory protective devices that had obtained official certification of approval from the Bureau of Mines on November 1, 1940. The manufacturers of this equipment have met the requirements and the devices have passed the tests for safety, practicability, and efficiency required when approval was granted. The detailed requirements are described in the schedules cited. The addresses of the manufacturers of approved devices are listed alphabetically at the end of this report.

Self-contained Oxygen Breathing Apparatus Approved Under Schedules 13, 13A, and 13B

1. Gibbs oxygen breathing apparatus. Approval BM-1300, issued to Mine Safety Appliances Co., January 15, 1920.

2. Paul oxygen breathing apparatus. Approval BM-1301, originally issued to American Atmos Corporation, January 15, 1920; later transferred to Mine Safety Appliances Co.

3. Fleuss-Davis Proto oxygen breathing apparatus. Approval BM-1302, issued to Siebe, Gorman & Co. (Ltd.), February 7, 1924.

4. McCaa oxygen breathing apparatus. Approval BM-1303, issued to Mine Safety Appliances Co., August 31, 1925.

5. *Draeger oxygen breathing apparatus (1924 type).* Approval BM-1304, issued to Draegerwerk, August 1, 1929.

6. *McCaa half-hour oxygen breathing apparatus.* Approval BM-1305, issued to Mine Safety Appliances Co., April 1, 1931.

7. *McCaa one-hour oxygen breathing apparatus.* Approval BM-1306, issued to Mine Safety Appliances Co., July 28, 1937.

Gas Masks Approved Under Schedules 14, 14A, 14B, and 14D

Type A: Acid Gas Masks

1. *M.S.A. hydrocyanic acid gas mask.* Approvals BM-1413 (regular-size canister) and BM-1414 (supersize canister), issued to Mine Safety Appliances Co., December 9, 1933.

2. *Acme chlorine gas mask.* Approval BM-1421, issued to Acme Protection Equipment Co., Inc., April 21, 1939.

3. *M.S.A. chlorine gas mask.* Approval BM-1422, issued to Mine Safety Appliances Co., May 26, 1939.

4. *Davis hydrocyanic acid gas mask.* Approval BM-1424, issued to Davis Emergency Equipment Co., Inc., December 11, 1939.

5. *Willson chlorine gas mask.* Approval BM-1426, issued to Willson Products, Inc., March 8, 1940.

6. *Davis chlorine gas mask.* Approval BM-1427, issued to Davis Emergency Equipment Co., Inc., June 26, 1940.

7. *Willson hydrocyanic acid gas mask.* Approval BM-1428, issued to Willson Products, Inc., August 30, 1940.

Type B: Organic Vapor Masks

1. *M.S.A. organic vapor mask.* Approval BM-1415, issued to Mine Safety Appliances Co., July 28, 1936.

2. *Davis organic vapor mask.* Approval BM-1417, issued to Davis Emergency Equipment Co., Inc., May 3, 1938.

3. *Acme organic vapor mask.* Approval BM-1418, issued to Acme Protection Equipment Co., Inc., May 13, 1938.

4. *Bullard organic vapor mask.* Approval BM-1419, issued to E. D. Bullard Co., July 15, 1938.

5. *Willson organic vapor mask.* Approval BM-1423, issued to Willson Products, Inc., October 6, 1939.

Type AB: Acid Gas and Organic Vapor Masks

1. M.S.A. acid gas and organic vapor mask. Approval BM-1409, issued to Mine Safety Appliances Co., January 23, 1930.

2. M.S.A. hydrogen sulfide and petroleum vapor mask. Approval BM-1410, issued to Mine Safety Appliances Co., July 16, 1930.

3. Davis acid gas and organic vapor mask. Approval BM-1411, issued to Davis Emergency Equipment Co., Inc., January 19, 1931.

4. M.S.A. hydrogen sulfide and petroleum vapor mask. Approval BM-1412, issued to Mine Safety Appliances Co., September 14, 1931.

5. M.S.A. hydrogen sulfide and petroleum vapor mask. Approval BM-1416, issued to Mine Safety Appliances Co., June 16, 1937.

Type C: Ammonia Gas Masks

1. M.S.A. ammonia gas mask. Approval BM-1401, issued to Mine Safety Appliances Co., April 10, 1920.

2. M.S.A. ammonia gas mask. Approval BM-1404, issued to Mine Safety Appliances Co., March 10, 1926.

3. LaFrance ammonia gas mask. Extension of approval BM-1401, issued to American-LaFrance and Foamite Industries, Inc., June 23, 1927.

4. M.S.A. ammonia gas mask. Approval BM-1406, issued to Mine Safety Appliances Co., February 14, 1928.

5. Davis ammonia gas mask. Approval BM-1408, originally issued to Bullard-Davis, Inc., December 19, 1928, later transferred to Davis Emergency Equipment Co., Inc.

6. LaFrance ammonia gas mask. Extension of approval BM-1408, issued to American-LaFrance and Foamite Industries, Inc., November 18, 1930.

7. McDonald ammonia gas mask. Extension of approval BM-1406, issued to the B.F. McDonald Co., May 17, 1938.

8. Acme ammonia gas mask. Approval BM-1420, issued to Acme Protection Equipment Co., Inc., March 25, 1939.

9. Willson ammonia gas mask. Approval BM-1425, issued to Willson Products, Inc., December 20, 1939.

Type D: Carbon Monoxide Gas Masks

1. M.S.A. self-rescuer. Approval BM-1402, issued to Mine Safety Appliances Co., March 6, 1924.

Type N: Universal Gas Masks

1. M.S.A. all-service gas mask. Approval BM-1403, issued to Mine Safety Appliances Co., July 1, 1925.

2. M.S.A. all-service gas mask. Approval BM-1405, issued to Mine Safety Appliances Co., August 24, 1928.

3. McDonald all-service gas mask. Extension of approval BM-1405, issued to B.F. McDonald Co., October 2, 1937.

Supplied-air Respirators Approved Under Schedules 19 and 19A

Type A: Hose Masks

1. M.S.A. combination hose mask. Approval BM-1901, issued to Mine Safety Appliances Co., May 29, 1929.

2. Davis hose mask. Approval BM-1902, issued to Davis Emergency Equipment Co., Inc., March 30, 1931.

3. Bullard hose mask. Approval BM-1903, issued to E. D.Bullard Co., April 14, 1933.

4. Davis hose mask. Approval BM-1904, issued to Davis Emergency Equipment Co., Inc., October 29, 1934.

5. M.S.A. combination hose mask. Approval BM-1905A, issued to Mine Safety Appliances Co., January 7, 1935.

6. Davis hose mask. Approval BM-1906, issued to Davis Emergency Equipment Co., Inc., August 2, 1935.

7. LaFrance hose mask. Extension of approval BM-1905A, issued to the American-LaFrance and Foamite Industries, Inc., September 20, 1937.

8. Acme supplied-air respirator, type A. Approval BM-1910, issued to Acme Protection Equipment Co., Inc., July 16, 1938.

Type B: Special Hose Masks Without Blowers

1. Davis air-line mask. Approval BM-1913, issued to Davis Emergency Equipment Co., Inc., March 10, 1939.

2. Bullard Simplex hose mask. Approval BM-1916, issued to E. D. Bullard Co., October 14, 1939.

Type C: Air-line Respirators

1. M.S.A. airline respirator. Approval BM-1909, issued to Mine Safety Appliances Co., July 15, 1938.

2. Willson air-line respirator models GA, GB, and GC. Approval BM-1912, issued to Willson Products, Inc., October 7, 1938.

3. Cesco No. 602 Healthguard direct air mask. Approval BM-1917, issued to Chicago Eye Shield Co., August 17, 1940.

Type CE: Abrasive Blasting Helmets, Hoods, or Masks

1. M.S.A. abrasive mask. Approval BM-1907, issued to Mine Safety Appliances Co., July 15, 1938.

2. Pangborn blast helmet, type DD-4. Approval BM-1908, issued to Pangborn Corporation, July 15, 1938.

3. Sly Purair helmet. Approval BM-1911, issued to W. W. Sly Manufacturing Co., July 16, 1938.

4. Willson No. 31 abrasive blasting helmet. Approval BM-1914, issued to Willson Products, Inc., March 10, 1939.

5. Pangborn blast helmet, type DF-2. Approval BM-1915, issued to Pangborn Corporation, March 23, 1939.

Dispersoid (Dust, Fume, and Mist) Respirators Approved Under Schedule 21

For the purpose of these approvals, the following definitions of the terms "dust," "fume," and "mist" are used:

Dust.- Dispersoids or particulate matter, smaller than about 0.1 mm. or 100 microns, formed by the disintegration of solid materials by such processes as crushing, grinding, and abrading.

Fume.- Solid dispersoids formed by the condensation of vapors such as those from heated metals and other substances.

Mist.- Liquid dispersoids formed by the disintegration of a liquid by such processes as spray-coating and atomizing.

Type A: Pneumoconiosis-producing and Nuisance Dust Respirators

These respirators are approved only for protection against the inhalation of pneumoconiosis-(silicosis- and asbestosis-) producing dusts, such as free silica and asbestos; and nuisance dusts, such as aluminum, cellulose, cement, charcoal, coal, coke, flour, gypsum, iron ore, limestone, and wood.

1. M.S.A. Comfo respirator. Approval BM-2101, issued to Mine Safety Appliances Co., January 7, 1935.

2. Willson bag respirator No. 300. Approval BM-2102, issued to Willson Products, Inc., January 21, 1935.

3. Willson bag respirator No. 400. Approval BM-2103, issued to Willson Products, Inc., January 21, 1935.

4. Pulmosan M-15 pouch-type filter respirator. Approval BM-2104, issued to Pulmosan Safety Equipment Corporation, February 9, 1935.

5. Biever respirator. Approval BM-2105, issued to Standard Safety Equipment Co., March 5, 1935.

6. Willson bag respirator No. 4. Approval BM-2106, issued to Willson Products, Inc., May 27, 1935.

7. Pulmosan M-1100 pouch-type filter respirator. Approval BM-2109, issued to Pulmosan Safety Equipment Corporation, March 23, 1936.

8. Cover No. 24 Dupor respirator. Approval BM-2111, issued to H. S. Cover, September 15, 1936.

9. Cesco No. 90 Healthguard respirator. Approval BM-2113, issued to Chicago Eye Shield Co., December 16, 1936.

10. McDonald Dustfoe respirator. Approval BM-2115, issued to B. F. McDonald Co., October 8, 1937.

11. M.S.A. Dustfoe respirator. Extension of approval BM-2115, issued to Mine Safety Appliances Co., November 23, 1937.

12. Willson bag respirator No. 100. Approval BM-2117, issued to Willson Products, Inc., December 27, 1937.

13. Willson Rotiform respirator No. 200. Approval BM-2118, issued to Willson Products, Inc., December 30, 1937.

14. Willson respirator No. 750. Approval BM-2119, issued to Willson Products, Inc., January 3, 1938.

15. Pulmosan D-4100 Duo-filter respirator. Approval BM-2120, issued to Pulmosan Safety Equipment Corporation, January 12, 1938.

16. American Optical Co., R 1000 respirator. Approval BM-2121, issued to American Optical Co., February 3, 1938.

17. Hygeia Filto-Ring No. 28 respirator. Approval BM-2122, issued to Hygeia Respirator Co., March 23, 1938.

18. Cover Dupor Skin-A-Cat respirator No. 40. Approval BM-2129, issued to H.S. Cover, July 5, 1939.

19. M.S.A. Comfo respirator. Approval BM-2130, issued to Mine Safety Appliances Co., August 23, 1939.

20. McDonald Dustfoe respirator. Approval BM-2132, issued to B. F. McDonald Co., August 23, 1939.

21. M.S.A. Dustfoe respirator. Extension of approval BM-2132, issued to Mine Safety Appliances Co., August 23, 1939.

22. M.S.A. alkali-dust respirator. Approval BM-2136, issued to Mine Safety Appliances Co., December 1, 1939.

23. American Optical Co. R9100 respirator. Approval BM-2137, issued to American Optical Co., March 6, 1940.

24. Willson No. 5 respirator. Approval BM-2140, issued to Willson Products, Inc., September 28, 1940.

25. DeVilbiss MSD respirator. Approval BM-2141, issued to The DeVilbiss Co., October 3, 1940.

Toxic Dust Respirators

These respirators formerly were designated "lead dust." Approval has been extended to cover all toxic or poisonous dusts, such as lead, cadmium, arsenic, chromium, manganese, selenium, vanadium, and their compounds.

1. M.S.A. Comfo respirator. Approval BM-2107, issued to Mine Safety Appliances Co., August 9, 1935.

2. Pulmosan L-2100 pouch-type filter respirator. Approval BM-2100 issued to Pulmosan Safety Equipment Corporation, July 17, 1936.

3. Willson Rotiform respirator No. 200L. Approval BM-2123, issued to Willson Products, Inc., April 18, 1938.

4. Willson respirator No. 750L. Approval BM-2125, issued to Willson Products, Inc., October 19, 1938.

5. McDonald Dustfoe respirator. Approval BM-2126, issued to the B.F. McDonald Co., March 10, 1939.

6. M.S.A. Dustfoe respirator. Extension of approval BM-2126, issued to Mine Safety Appliances Co,, March 10, 1939.

7. American Optical Co. R1000T respirator. Approval BM-2138, issued to American Optical Co., March 16, 1940.

Pneumoconiosis-Producing, Nuisance, and Toxic Dust Respirators

These respirators formerly were designated "Type A and lead dust." Approval has been extended to cover all dusts.

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1. Willson bag respirator No. 400L. Approval BM-2108, issued to Willson Products, Inc., September 5, 1935.

2. Pulmosan ML-3100 pouch-type filter respirator. Approval BM-2112, issued to Pulmosan Safety Equipment Corporation, November 30, 1936.

3. Cesco Healthguard No. 91 respirator. Approval BM-2114, issued to Chicago Eye Shield Co., August 6, 1937.

4. Cesco Healthguard No. 92 respirator. Approval BM-2116, issued to Chicago Eye Shield Co., November 8, 1937.

5. Cover Dupor No. 46 respirator. Approval BM-2124, issued to H.S. Cover, October 3, 1938.

6. Willson respirator No. 752L. Approval BM-2127, issued to Willson Products, Inc., March 10, 1939.

7. M.S.A. Comfo respirator. Approval BM-2133, issued to Mine Safety Appliances Co., October 13, 1939.

8. McDonald Dustfoe respirator. Approval BM-2134, issued to B. F. McDonald Co., October 13, 1939.

9. M.S.A. Dustfoe respirator. Extension of approval BM-2134, issued to Mine Safety Appliances Co., October 13, 1939.

10. Cesco Healthguard No. 94 respirator. Approval BM-2142, issued to Chicago Eye Shield Co., October 3, 1940.

Type B: Fume Respirators

These respirators are approved for protection against the inhalation of fumes (solid dispersoids or particulate matter formed by the condensation of vapors such as those from heated metals and other substances).

1. Willson respirator No. 770. Approval BM-2128, issued to Willson Products, Inc., April 15, 1939.

2. M.S.A. Comfo respirator. Approval BM-2139, issued to Mine Safety Appliances Co., March 27, 1940.

Pneumoconiosis-producing Dust and Mist and Chromic Acid Mist Respirators

These respirators are for protection against the inhalation of pneumoconiosis-producing dusts, such as free silica and asbestos; nuisance dusts, such as aluminum, cellulose, cement, charcoal, coal, coke, flour, gypsum, iron, or limestone, and wood; pneumoconiosis-producing mist, such as is produced by spray coating and atomizing; and chromic acid mist, such as is produced in chromium plating.

1. M.S.A. Comfo respirator. Extension of approval BM-2101, issued to Mine Safety Appliances Co., May 27, 1935.

2. Willson respirator No. 750. Extension of approval BM-2119, issued to Willson Products, Inc., June 3, 1938.

3. M.S.A. Comfo respirator. Approval BM-2130, issued to Mine Safety Appliances Co., August 23, 1939.

4. McDonald Dustfoe respirator. Approval BM-2132, issued to B. F. McDonald Co., August 23, 1939.

5. M.S.A. Dustfoe respirator. Extension of approval BM-2132, issued to Mine Safety Appliances Co., August 23, 1939.

6. Willson No. 5 respirator. Approval BM-2140, issued to Willson Products, Inc., September 28, 1940.

APPROVAL LABELS

To provide purchasers and users with a means for identifying approved devices and for procuring approved parts when making repairs and replacements the Bureau requires that all devices marketed under the provisions of the approval system of the Federal Bureau of Mines must have an approval label on which is reproduced the seal of the Bureau of Mines, the approval number, the name of the manufacturer to whom the approval is issued, and the conditions for which approval is granted. Essential parts of the devices are marked with the approval number. The markings also obligate the manufacturer to maintain the quality of the product and to construct each device, in all its parts, in exact accordance with specifications of the device that the Bureau examined and approved. Any device that exhibits changes in design or includes any parts that were not in the device approved, regardless of whether the change is made by the manufacturer or the consumer, is not permissible and must not bear the Bureau of Mines approval label.

The approval label (metal plate) is affixed to self-contained oxygen breathing apparatus. Canister-type gas masks bear a label on the case and on each canister, and the approval number is marked on the facepiece and harness, for example, "BM-1400." Type A (hose mask) and type B (special hose mask without blower) supplied-air respirators have the approval label on their cases or containers, and the approval number is marked on the air-supply arrangement, air-supply line, facepiece, and harness. Type C (air-line respirator) and type CE (abrasive-blasting respirator) have the approval label on their cases (if any) or on a special sheet with instructions for use of the device; and the approval number is marked on the air-supply line, respiratory-inlet covering (facepiece, hood, or helmet), and harness. The containers of dispersoid respirators and of replacement-filter units bear approval labels, and the approval number is marked on the facepiece and each filter unit. The filter units also bear a marking that designates the type of particulate matter for which they are approved, as pneumoconiosis-producing and nuisance dusts, toxic dusts, and fumes.

NAMES AND ADDRESSES OF COMPANIES THAT HAVE RECEIVED APPROVALS

Acme Protection Equipment Co., 3616 Liberty Avenue, Pittsburgh, Pa.
American-LaFrance and Foamite Industries, Inc., Elmira, N.Y.
American Optical Co., Southbridge, Mass.
E. D. Bullard Co., 275 8th Street, San Francisco, Calif.
Chicago Eye Shield Co., 2300 Warren Boulevard, Chicago, Ill.
H.S. Cover, Station A, South Bend, Ind.
Davis Emergency Equipment Co., Inc., 55 Van Dam Street, New York, N. Y.
The DeVilbiss Co., Toledo, Ohio.
Draegerwerk, Lübeck, Germany.
Hygeia Respirator Co., 129 East 85th St., New York, N. Y.
B. F. McDonald Co., 1248 South Hope Street, Los Angeles, Calif.
Mine Safety Appliances Co., Braddock, Thomas, and Meade Streets, Pittsburgh, Pa.
Pangborn Corporation, Hagerstown, Md.
Pulmosan Safety Equipment Corporation, 176 Johnson Street, Brooklyn, N. Y.
Siebe, Gorman & Co., Ltd., London, England.
W. W. Sly Manufacturing Co., 4700 Train Avenue, Cleveland, Ohio.
Standard Safety Equipment Co., 75 East Wacker Drive, Chicago, Ill.
Willson Products, Inc., Reading, Pa.

DISPERSOID RESPIRATORS APPROVED BY
THE UNITED STATES DEPARTMENT OF THE INTERIOR, BUREAU OF MINES

DUST RESPIRATORS

A. Dust Respirators - (for all dusts)

Willson No. 400L
BM-2108 - 8-5-36
F - I - FI*

Pulmosan ML-3100
BM-2112 - 11-30-36
F - I

Cesco No. 91
BM-2114 - 8-6-37
F - I

Cesco No. 92
BM-2116 - 11-8-37
F - I*

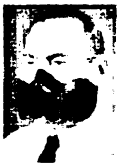
Cover No. 46
BM-2124 - 10-3-38
F - I - FI*

Willson No. 752L
BM-2127 - 3-10-39
F - I - FI*

M. S. A. Comfo
BM-2133 - 10-13-39
P - I* - FI*

M. S. A. Comfo
Navy type facepiece
I*

McDonald and M.S.A.
Dustfoe
BM-2134 - 10-13-39
P - I - FI*


Cesco No. 94
BM-2142 - 10-3-40
P

B. Pneumoconiosis-Producing and Nuisance Dust Respirators

M. S. A. Comfo
BM-2101* - 1-7-35
FP - I* - FI*
BM-2130* - 8-23-39
P - I* - FI*

Willson No. 300
BM-2102 - 1-21-35
F - I - FI*

Willson No. 400
BM-2103 - 1-21-35
F - I - FI*

Pulmosan M-15
BM-2104 - 2-9-35
F - I

Biever
BM-2105 - 3-5-35
F - I

Willson No. 4
BM-2106 - 5-27-35
F - I - FI*

Pulmosan M-1100
BM-2109 - 3-23-36
F - I

Cover No. 24
BM-2111 - 9-15-36
F - FI*

McDonald and M.S.A.
Dustfoe
BM-2115 - 10-8-37
FP - I - FI*
BM-2132* - 8-23-39
P - I - FI*

Willson No. 100
BM-2117 - 12-27-37
F - FI

Willson No. 200
BM-2118 - 12-30-37
F - I - FI*

Willson No. 750
BM-2119* - 1-3-38
P - I - FI*

Pulmosan D-4100
BM-2120 - 1-12-38
F

A. O. R1000
BM-2121 - 2-3-38
F - I

Hygeia No. 28
BM-2122 - 3-23-38
F

Cover No. 40
BM-2129 - 7-5-39
F - I - FI*

M.S.A. Alkali Dust
BM-2136 - 12-1-39
P - I

A. O. R8100
BM-2137 - 3-6-40
F

Willson No. 5
BM-2140* - 9-28-40
P - I

DeVilbiss MSC
BM-2141 - 10-3-40
F - I

*These respirators are also approved for pneumoconiosis-producing, chromic acid, and nuisance mists.

C. Toxic-Dust Respirators

M. S. A. Comfo
BM-2107 - 8-9-35
FP - I* - FI*

Pulmosan L-2100
BM-2110 - 7-17-36
F - I

Willson No. 200L
BM-2123 - 4-18-38
F - I - FI*

Willson No. 750L
BM-2125 - 10-19-38
P - I - FI*

McDonald and M.S.A.
Dustfoe
BM-2126 - 3-10-39
FP - I - FI*

A. O. R1000T
BM-2138 - 3-16-40
F - I

FUME RESPIRATORS

Willson No. 770
BM-2128 - 4-15-39
F - I

M. S. A. Comfo
BM-2139 - 3-27-40
P - I*

II. MIST RESPIRATORS - (See footnote to Section I. B.)

Code

F = felt filter; P = paper; and FP = felt + paper. I = inhalation valves. FI = facelet. * = use of indicated part is optional.

Addresses

American Optical Co., Southbridge, Mass.
Biever - Standard Safety Equipment Co., 75 E. Wacker Drive, Chicago, Ill.
Cesco - Chicago Eye Shield Co., 2300 Warren Blvd., Chicago, Ill.
H. S. Cover, Station A, South Bend, Ind.
DeVilbiss Co., Toledo, Ohio

Hygeia Respirator Co., 129 E. 85th St., N.Y.C.
B. F. McDonald Co., 1248 S. Hope St., Los Angeles, Cal.
Mine Safety Appliances Co., Pittsburgh, Pa.
Pulmosan Safety Equip. Corp., Brooklyn, N. Y.
Willson Products, Inc., Reading, Pa.